

A History of Embryology (1959), by Joseph Needham

[1]

By: Wellner, Karen Keywords: [History](#) [2]

In 1931 embryologist and historian [Joseph Needham](#) [3] published a well-received three-volume treatise titled *Chemical Embryology* [4]. The first four chapters from this work were delivered as lectures on *Speculation, Observation, and Experiment* [5], as illustrated by the history of embryology at the University of London. The same lectures were later released as a book published in 1934 titled *A History of Embryology*. This monograph represents one of the first general accounts of the history of embryology [6] and presents embryology [6] as a history of intertwined ideas, a style of historical writing advanced by noted biology historian Jane Oppenheimer. A revised 1959 edition of the text published by Abelard and Schuman, New York, examines the history of embryology [6] from antiquities to the mid-nineteenth century. [Arthur Hughes](#) [7], lecturer in anatomy at [Cambridge University](#) [8], is credited by Needham as providing technical assistance with the new version.

The second edition of *A History of Embryology* is divided into four chronologically arranged chapters that cover embryology [6] from antiquity to the end of the eighteenth century. Throughout the text Needham gives attention to the development of quantification and experimentation within the field of embryology [6]. There are many direct quotations from embryologists that help give context for the time periods in which the embryologists worked. Particularly useful to embryology [6] historians are two timelines illustrations that identify well-known and lesser-known embryologists and when they lived.

In chapter one Needham investigates what ideas early peoples had about babies and embryos. Around 1400 BC Egyptians made reference to the [placenta](#) [9] and its importance as the seat of the external soul. However, they did not consider an embryo alive until the baby was born. The early Egyptians also discovered that [chick](#) [10] eggs could be removed from nests and artificially incubated in ovens. This important finding allowed for observation of [chick](#) [10] embryos during different periods of development.

The first written record of embryological research is attributed to [Hippocrates](#) [11] (460 BC–370 BC) who wrote about obstetrics and gynecology. In this regard Needham declares that [Hippocrates](#) [11], and not [Aristotle](#) [12], should be recognized as the first true embryologist. [Hippocrates](#) [11] believed that the embryo began development by extracting moisture and breath from the mother and he identified a series of condensations and fires that were responsible for the development of bones, belly, and circulation in the embryo and [fetus](#) [13]. He also supported the view that the human [fetus](#) [13] gained nourishment by sucking blood from the [placenta](#) [9]. Needham credits [Hippocrates](#) [11] with being one of the first to allude to the concept of preformationism with the Greek physician's belief that organisms were fully formed in miniature inside [germ cells](#) [14]. This belief helped give rise to [theological embryology](#) [15] or the idea that various souls entered the embryo as it grew.

The remainder of the first chapter examines the well-known observational science of [Aristotle](#) [12] (384 BC–322 BC) and his responsibility for the continued growth of embryology [6]. [Aristotle](#) [12] studied embryos of different organisms by opening up bird eggs at different stages of development and dissecting mammalian and cold-blooded embryos. Needham argues that [Aristotle](#) [12] may have even observed a human embryo—an extraordinary feat for a scientist at the time given that aborted embryos were not that easy to come by. [Aristotle](#) [12] also argued that [semen](#) [16] supplied the form or breath to embryos and mothers supplied some type of substance to aid in embryonic development. Although the role of menstrual blood was not understood it was targeted by [Aristotle](#) [12] as the most likely substance out of which the embryo was made. Needham suggests that [Aristotle](#) [12] also addressed an early idea of recapitulation (although this was not the word that he used), with embryos as his guide. He observed that young embryos of different species all possessed universal characteristics and that as the embryos aged, differentiating characteristics arose.

The second chapter examines embryology [6] from [Galen](#) [17] of Pergamos through the Renaissance. [Galen](#) [17] mainly wrote from 150 AD to 180 AD and as well known as [Galen](#) [17] is, he is only afforded several pages by Needham. This no doubt reflects on the lack of attention given to the embryo by [Galen](#) [17] during this time period. [Galen](#) [17] is credited by the author as being a vitalist (life arises from or contains a nonmaterial vital principle) and teleologist (all life and actions are driven by an ultimate purpose) whose main contribution to embryology [6] was his steadfast belief that the [umbilical cord](#) [18] was necessary for respiration. After [Galen](#) [17], Needham briefly addresses embryology [6] among the Arabs, but it is a mere page in length. Needham insists that the Arab world may have been successful in optics and astronomy, but not in embryology [6].

Needham credits [Albertus Magnus](#) [19] (also known as Albert of Cologne) for the reawakening of scientific embryology [6]. Before the early 1200s, observational embryology [6] had been replaced by theology and speculative theories and the field had toiled for hundreds of years in a seemingly dead period. Albert resembled [Aristotle](#) [12] in his observational techniques and attention to

detail and he frequently discussed [embryology](#)^[6] in his books. Albert believed that women had seeds and that female seeds coagulated, much like cheese, after coming in contact with male seeds. When a coagulated seed made contact with menstrual blood, the seed now had the nutrition necessary for proper development. Albert also studied [chick](#)^[10] and [fish](#)^[20] embryos and wrote extensively about each organism's development, helping to bring [embryology](#)^[6] back into the observational and scientific realm.

The remaining section of chapter two is devoted to the embryological findings of [Leonardo da Vinci](#)^[21] whose work dominated science in the late 1400s and early 1500s. Leonardo is noted for his dissection of the human [fetus](#)^[13] and his quantitative measurements of embryonic growth. He was the first to provide evidence that embryos can be measured chronologically and that they change in weight, size, and shape over time. The sixteenth century also saw the recognition of the field of gynecology. Clinical textbooks were published and helped fuel an emerging new interest in human development. The growth of midwifery during the late 1500s has a direct connection with the availability of illustrated obstetrical literature that became more mainstreamed during this time.

In chapter three Needham examines [embryology](#)^[6] in the seventeenth century and introduces the [embryology](#)^[6]-related work of [William Harvey](#)^[22] (1578 AD–1667 AD). As early as 1652, Harvey dissected and examined deer and [chicken](#)^[23] embryos with the aid of low powered lenses. Harvey determined the position where the embryo arises in an [egg](#)^[24], the so-called white spot, and described the [blastoderm](#)^[25] as the unique place of origin of the embryonic body. He also wrote of the importance of the amniotic fluid, believing that it was absorbed into the blood of the embryo and later, the [fetus](#)^[13]. Harvey also lent his voice to the refutation of [spontaneous generation](#)^[26] in describing how even the lowest organisms arise from eggs.

Needham credits Italian biologist Marcello Malpighi (1628 AD–1694 AD) as the person responsible for the rise of preformationist doctrine. Malpighi described embryo development as a simple unfolding of an already miniature adult organism. At about the same time, [Jan Swammerdam](#)^[27], a noted [frog](#)^[28] embryologist also supported preformationism after seeing folded butterflies in chrysalises. To Swammerdam, adult butterflies were simply masked (performed) inside of caterpillars.

Needham points out several other important embryological findings during the seventeenth century. Nicholas Stensen discovered the follicles of the mammalian [ovary](#)^[29] in dogfish and demonstrated that the human female [ovary](#)^[29] was homologous to the ovaries in previously studied [oviparous](#)^[30] animals. Stensen declared that the human [ovary](#)^[29] housed eggs, yet not all breakthroughs revolved around eggs. As rudimentary microscopes became more available, so too did the number of observations of [spermatozoa](#)^[31], mainly from different species of [fish](#)^[20]. During the late 1600s embryos with severe congenital malformations, called embryonic monsters at the time, began to receive scientific descriptions. A detailed 1686 drawing of a [teratoma](#)^[32] with well-formed teeth and hair is presented in the text.

In the last chapter of *A History of Embryology* Needham describes how eighteenth century embryologists continued to be befuddled about fetal nutrition. The author presents a chronological table that identifies scientists and their competing ideas about what the [fetus](#)^[13] did in order to grow and survive. These ideas range from amniotic fluid taken in by the mouth of the [fetus](#)^[13], nutrition passing through the [umbilical cord](#)^[18], nutrition circulating with menstrual blood, and an innocuous fluid made available to the [fetus](#)^[13] called uterine milk. Even the origin of amniotic fluid caused puzzlement during this time period. Two competing ideas were that amniotic fluid came from the sweat of the [fetus](#)^[13] or that it was secreted from the eyes and mouth of the crying and salivating [fetus](#)^[13]. Without sound experimental techniques these questions remained unsolved during the eighteenth century.

Preformationism had become firmly established by the early 1700s and Needham credits this to the writings of Malpighi, Swammerdam, and [Charles Bonnet](#)^[33] and to embryologists who proclaimed to see minute forms of men inside of gametes. Among these animalculists a division arose between those who believed that preformed organisms existed in eggs (ovists) and those who believed that small adult organisms existed in [sperm](#)^[34] (spermists). Noted animalculists included Anton van Leeuwenhoek, Nicholas Hartsoecker, and Wilhelm Gottfried Leibniz. At this time preformationists outnumbered the number of epigeneticists (those who believed that development proceeded progressively from unorganized matter), but there still remained many unanswered questions. Epigeneticists asked how embryonic monsters and regeneration of [starfish](#)^[35] arms fit into the [preformation](#)^[36] plan of a God that had made sure that all normal adult structures were in the [egg](#)^[24] or the [semen](#)^[16], waiting to unfold. Needham details how the [preformation](#)^[36]-[epigenesis](#)^[37] debate grew and culminated in a series of arguments between epigeneticist [Caspar Friedrich Wolff](#)^[38] and preformationist [Albrecht von Haller](#)^[39]. Wolff published *De Formatione Intestini* in 1768 and demonstrated that the [chick](#)^[10] intestine forms by the folding of tissue that detaches from the embryo's ventral surface. The folds eventually transform into a closed tube. Wolff argued that this observation proved that the intestine was not preformed and that organs appeared gradually. Wolff also examined embryonic monsters, declaring that they were formed by nature and stood as examples of [epigenesis](#)^[37] rather than preformationism. Haller, however, was much better known to scientists than Wolff, and Haller's powerful influence did much to sustain preformationism through the late 1700s.

Needham credits [Hermann Boerhaave](#)^[40] with having written the first detailed account of chemical [embryology](#)^[6] in his book *Elementa Chemiae* published in 1724. Boerhaave separated [egg](#)^[24] white from the [yolk](#)^[41] and added various acids and bases, heated them, shook them, and boiled them to see the chemical and physical effects that each procedure had on albumin. This type of experimentation soon gave rise to the science of techniques and paved the way for later experimental work by such

embryologists as [Jacques Loeb](#) ^[42] and [Hans Spemann](#) ^[43].

Needham ends the fourth chapter by identifying several important embryological discoveries that occurred before the closing of the eighteenth century. The mammalian [egg](#) ^[24] was finally seen and recognized as a single cell; the idea of the [recapitulation theory](#) ^[44] began to take shape; and Scottish surgeon [John Hunter](#) ^[45] showed that the maternal and fetal circulations were distinct physiologies.

Needham's concluding remarks reflect on why the history of [embryology](#) ^[6] has turned out the way it has. Needham argues that advancements in [embryology](#) ^[6] rarely proceed with separate successions of geniuses but rather with embryologists who have inherited the observations and remarks of previous generations of scientists. He argues that much of early [embryology](#) ^[6] was descriptive in nature due to several limiting factors: social and political ruling ideas, cooperation (or lack of cooperation) of scholars, language barriers, and technology (his examples include the introduction of hardening agents, especially alcohol and improvements in [microscopy](#) ^[46]). The overarching emphasis of Needham's historical survey is to describe how a collaboration of speculative thought, accurate observations, and controlled experiments give great coherence to [embryology](#) ^[6]. Needham argues that any modification of this balance acts as a powerful limiting factor itself.

Sources

1. Bodemer, Charles W. Review of "A History of Embryology" by [Joseph Needham](#) ^[3], " *Isis* 52 (1961): 109–110.
2. Cave, A. J. E. "Review of "A History of Embryology" by [Joseph Needham](#) ^[3]," *Folklore* 46 (1935): 181–82.
3. Needham, Joseph. *A History of Embryology*. New York: Abelard-Schuman, 1959.
4. Oppenheimer, Jane M. "Reflections on Fifty Years of Publications on the History of General Biology and Special Embryology," [The Quarterly Review of Biology](#) ^[47] 5 (1975): 373–87.

In 1931 embryologist and historian Joseph Needham published a well-received three-volume treatise titled *Chemical Embryology*. The first four chapters from this work were delivered as lectures on Speculation, Observation, and Experiment, as Illustrated by the History of Embryology at the University of London. The same lectures were later released as a book published in 1934 titled *A History of Embryology*. This monograph represents one of the first general accounts of the history of embryology and presents embryology as a history of intertwined ideas, a style of historical writing advanced by noted biology historian Jane Oppenheimer. A revised 1959 edition of the text published by Abelard and Schuman, New York, examines the history of embryology from antiquities to the mid-nineteenth century. Arthur Hughes, lecturer in anatomy at Cambridge University, is credited by Needham as providing technical assistance with the new version.

Subject

[Needham, Joseph, 1900-1995](#) ^[48]

Topic

[Publications](#) ^[49]

Publisher

Arizona State University. School of Life Sciences. Center for Biology and Society. Embryo Project Encyclopedia.

Rights

© Arizona Board of Regents Licensed as Creative Commons Attribution-NonCommercial-Share Alike 3.0 Unported (CC BY-NC-SA 3.0) <http://creativecommons.org/licenses/by-nc-sa/3.0/>

Format

[Articles](#) ^[50]

Last Modified

Wednesday, July 4, 2018 - 04:40

DC Date Accessioned

Thursday, May 10, 2012 - 14:06

DC Date Available

Thursday, May 10, 2012 - 14:06

DC Date Created

2010-06-28

DC Date Created Standard

Monday, June 28, 2010 - 07:00

- [Contact Us](#)

© 2021 Arizona Board of Regents

- The Embryo Project at Arizona State University, 1711 South Rural Road, Tempe Arizona 85287, United States

Source URL: <https://embryo.asu.edu/pages/history-embryology-1959-joseph-needham>

Links

- [1] <https://embryo.asu.edu/pages/history-embryology-1959-joseph-needham>
- [2] <https://embryo.asu.edu/keywords/history>
- [3] <https://embryo.asu.edu/search?text=Joseph%20Needham>
- [4] <https://embryo.asu.edu/search?text=Chemical%20Embryology>
- [5] <https://embryo.asu.edu/search?text=Experiment>
- [6] <https://embryo.asu.edu/search?text=embryology>
- [7] <https://embryo.asu.edu/search?text=Arthur%20Hughes>
- [8] <https://embryo.asu.edu/search?text=Cambridge%20University>
- [9] <https://embryo.asu.edu/search?text=placenta>
- [10] <https://embryo.asu.edu/search?text=chick>
- [11] <https://embryo.asu.edu/search?text=Hippocrates>
- [12] <https://embryo.asu.edu/search?text=Aristotle>
- [13] <https://embryo.asu.edu/search?text=fetus>
- [14] <https://embryo.asu.edu/search?text=germ%20cells>
- [15] <https://embryo.asu.edu/search?text=theological%20embryology>
- [16] <https://embryo.asu.edu/search?text=semen>
- [17] <https://embryo.asu.edu/search?text=Galen>
- [18] <https://embryo.asu.edu/search?text=umbilical%20cord>
- [19] <https://embryo.asu.edu/search?text=Albertus%20Magnus>
- [20] <https://embryo.asu.edu/search?text=fish>
- [21] <https://embryo.asu.edu/search?text=Leonardo%20da%20Vinci>
- [22] <https://embryo.asu.edu/search?text=William%20Harvey>
- [23] <https://embryo.asu.edu/search?text=chicken>
- [24] <https://embryo.asu.edu/search?text=egg>
- [25] <https://embryo.asu.edu/search?text=blastoderm>
- [26] <https://embryo.asu.edu/search?text=spontaneous%20generation>
- [27] <https://embryo.asu.edu/search?text=Jan%20Swammerdam>
- [28] <https://embryo.asu.edu/search?text=frog>
- [29] <https://embryo.asu.edu/search?text=ovary>
- [30] <https://embryo.asu.edu/search?text=oviparous>
- [31] <https://embryo.asu.edu/search?text=spermatozoa>
- [32] <https://embryo.asu.edu/search?text=teratoma>
- [33] <https://embryo.asu.edu/search?text=Charles%20Bonnet>
- [34] <https://embryo.asu.edu/search?text=sperm>
- [35] <https://embryo.asu.edu/search?text=starfish>
- [36] <https://embryo.asu.edu/search?text=preformation>
- [37] <https://embryo.asu.edu/search?text=epigenesis>
- [38] <https://embryo.asu.edu/search?text=Caspar%20Friedrich%20Wolff>
- [39] <https://embryo.asu.edu/search?text=Albrecht%20von%20Haller>
- [40] <https://embryo.asu.edu/search?text=Hermann%20Boerhaave>
- [41] <https://embryo.asu.edu/search?text=yolk>
- [42] <https://embryo.asu.edu/search?text=Jacques%20Loeb>
- [43] <https://embryo.asu.edu/search?text=Hans%20Spemann>
- [44] <https://embryo.asu.edu/search?text=recapitulation%20theory>
- [45] <https://embryo.asu.edu/search?text=John%20Hunter>
- [46] <https://embryo.asu.edu/search?text=microscopy>
- [47] <https://embryo.asu.edu/search?text=The%20Quarterly%20Review%20of%20Biology>
- [48] <https://embryo.asu.edu/library-congress-subject-headings/needham-joseph-1900-1995>
- [49] <https://embryo.asu.edu/topics/publications>
- [50] <https://embryo.asu.edu/formats/articles>